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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/976,313	10/11/2001	Williams L. Harrison III	42390P12907	1914

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EXAMINER

VU, TUAN A

ART UNIT	PAPER NUMBER
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2124

DATE MAILED: 10/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/976,313

Applicant(s)

HARRISON ET AL.

Examiner

Tuan A Vu

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
  - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
  - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
  - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 11 October 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 October 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_

### DETAILED ACTION

1. This action is responsive to the application filed October 11, 2001.

Claims 1-20 have been submitted for examination.

#### *Claim Rejections - 35 USC § 101*

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 1, 7, 13 and 19 rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

The Federal Circuit has recently applied the practical application test in determining whether the claimed subject matter is statutory under 35 U.S.C. § 101. The practical application test requires that a “useful, concrete, and tangible result” be accomplished. An “abstract idea” when practically applied is eligible for a patent. As a consequence, an invention, which is eligible for patenting under 35 U.S.C. § 101, is in the “useful arts” when it is a machine, manufacture, process or composition of matter, which produces a concrete, tangible, and useful result. The test for practical application is thus to determine whether the claimed invention produces a “useful, concrete and tangible result”.

**As per claim 1**, here is recited a method comprising assigning an alias to each equivalence class of overlapping memory accesses as analyzed from an intermediate language program; and defining a definition-use relationship for statements of said equivalence class with definition-statements and use-statements to reference the alias associated with said equivalence class. The above steps of assigning and defining do not amount to generating a concrete, tangible, and useful result in any art of programming. Even though the claim elaborates on how such defining is being made, there is no reciting of any action or purpose in relation with the defining and assigning as being done or intended for or by the program being analyzed; i.e. there is no evidence that this method is leading to useful application as required by the practical

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application test from above. Hence, the claim merely amounts to an abstract idea, and is rejected for leading to a non-statutory subject matter.

As per claims 7, 13, and 19, these claims are computer-medium claim, apparatus claim for performing the same steps recited in claim 1; hence are marred with the same type of deficiency as mentioned therein; and are thereby also rejected for leading to a non-statutory subject matter.

### ***Claim Objections***

4. Claims 6, 12, and 18 are objected to because of the following informalities: The limitation 'form' should refer to a 'set of values' as such set is being joined to complete an order; hence should be in 3<sup>rd</sup> person format verb like in 'forms'. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claim 13 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 13 recites the limitation "redefining" in line 8. There is insufficient antecedent basis for this limitation in the claim because there is no mention of definition-use relationship being defined prior to such 'redefining' limitation, which will be interpreted as 'defining' to enable examining the merits of the claim.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

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7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1-4, 7-10, 13-16, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pande et al., "Interprocedural Def-Use Association in C Programs", *Proceedings of the symposium on Testing, analysis, and verification*, pp. 139-153, October 1991 (hereinafter Pande), in view of Harrold et al., "Efficient Computation of Interprocedural Definition-Use Chains", *ACM Transactions on Programming Languages and Systems (TOPLAS)*, Volume 16 Issue 2, March 1994, pp. 175-204 ( hereinafter Harrold).

As per claim 1, Pande discloses a method comprising assigning an alias to each equivalence class of possibly overlapping memory accesses ( e.g. *conflict analysis* – L column, 2<sup>nd</sup> para pg. 141; Fig. 12 – Note: identification of one memory conflict operations is equivalent to identifying one equivalence class) as defined by an alias analysis of an intermediate language (e.g. *Alias, aliased* - ch. 2.2. pg 141-142; Fig. 1, pg. 142 – Note: working with CFG is equivalent to analyzing memory access or references from an intermediate code ); and

defining a definition-use relationship between statements in each equivalence class ( e.g. *def-use association* – ch. 2.2. pg 141)

But Pande does not explicitly disclose definition-use relationship defining wherein definition-statements pertaining to the equivalence class reference the alias associated with that class and wherein use-statements pertaining to the equivalence class reference the alias associated with that class. The concept of creating a definition operation and a use operation in

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order to resolve a alias as disclosed by Pande already suggest a tight association of the alias with either a definition or use instruction. In the same line of approach as Pande's approach to create reaching definition ( Pande: ch. 4.1.1- 4.1.3, 4-2), the defining of definition-type operations and use-type operations into separate sets to refer to a alias or argument passing context is evidenced in Harrold's method, which is using IFG graph analogous to Pande to define definition-use association of interprocedural and analysis (e.g. DEF and UPEXP ch. 4.1, pg. 183) to support alias resolution ( ch. 5, pg. 195-197). Hence, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement separate sets of statements for definition instruction and use instruction referring to an alias such as taught by Harrold and add this to Pande's method (in case Pande does not already provide one such implementation) because for each type of definition or use operation the input and output information can be derived so as to evidence dependency from graph analysis, enabling interprocedural parameters passing or pointer referencing to be more visible or treated individually thereby accomplishing safer unaliasing or pointer dereferencing techniques as intended by Pande, thus help improving code size (Harrold: Fig. 12, ch. 6-8 , pg. 197-200).

**As per claim 2**, Pande discloses constructing a dependence flow but does not explicitly disclose comprising assigning a definition-node for each definition statement in the program; assigning a use-node for each use statement in the program; assigning an alias-node for each alias; introducing a single edge into the graph connecting each definition-node to its associated alias-node; and introducing a single edge in the graph connecting each use-node to its associated alias-node.

But in light of the creation of a flow graph taking mark or strong note of an alias parameter as taught by Harrold (e.g. Fig. 12, pg. 198) by providing edge to such alias parameter node from all read and write operations, the above teaching are suggested; hence the motivation to provide a graph including use node and definition node associated via an edge to a common alias node as suggested by Harrold to Pande's method would have been obvious for the same rationale as set forth in claim 1 above.

**As per claim 3**, Official notice is taken that the main aliasing problem resolution being emphasized by commonly known techniques for eliminating operation that involve 2 differently named variables being accessed by a code read/write operation was a known concept at the time the invention was made; and since Pande is trying to resolve similar conflict with unaliasing techniques according to the teachings of such notice, Pande discloses performing a memory alias analysis of said intermediate language program to partition the memory accesses of said intermediate language program into equivalence classes such that any two memory accesses that reference the same storage location belong to the same equivalence class (( e.g. *conflict analysis* – L column, 2<sup>nd</sup> para pg. 141; Fig. 12 – re Note of claim 1).

**As per claim 4**, Pande discloses analysis using said dependence flow graph ( e.g. ch. 2-4).

**As per claim 7**, this claim is the computer-readable medium claim corresponding to method claim 1; hence is rejected with the corresponding rejection as set forth therein.

**As per claims 8-10**, these claims correspond to claims 2-4, respectively; and are rejected with the corresponding rejection as set forth therein.



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**As per claim 13**, this claim is the apparatus claim having set of instructions to perform a method corresponding to method claim 1; hence is rejected with the corresponding rejection as set forth therein.

**As per claims 14-16**, these claims correspond to claims 2-4, respectively; and are rejected with the corresponding rejection as set forth therein.

**As per claim 19**, this is a means/apparatus claim corresponding to claim 1; and is rejected with the respective rejections as set forth therein.

**As per claim 20**, refer to claim 2.

9. Claims 5-6, 11-12, 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pande et al., "Interprocedural Def-Use Association in C Programs", *Proceedings of the symposium on Testing, analysis, and verification*, pp. 139-153, October 1991, in view of Harrold et al., "Efficient Computation of Interprocedural Definition-Use Chains", *ACM Transactions on Programming Languages and Systems (TOPLAS)*, Volume 16 Issue 2, March 1994, pp. 175-204, as applied to claims 4, 10, 15; and further in view of Archambault, USPN: 6,173,444 (hereinafter Archambault).

**As per claim 5**, Pande does not disclose program analysis comprising:

- (a) for each alias-node in the dependence flow graph assigning an initial value to the alias corresponding to said alias-node and adding said alias-node to a set of nodes; and
- (b) while said set of nodes is not empty, iteratively performing the following:
  - removing a node from said set of nodes;
- (c) if said node is an alias-node then adding the successors of said node in the dependence flow graph to said set of nodes;

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(d) if said node is a definition-node for a statement of the form PUT (A, E) then determining a value for E, updating said initial value based on the value of E; and adding A to said set of nodes.

But according to the unaliasing technique disclosed by Harrold showing alias nodes being connected by read/write operation nodes and the techniques of calculating the reaches of definitions set for operations while traversing the CFG, the concept of resolving definition instruction in view of the use and reachability as in a CFG as taught by Pande (ch. 4.1.1- 4.1.3, 4-2) and propagation as by Harrold ( ch. 4) are reminiscent of steps (c ) and (d) above. In the same line of approach to optimize pointer variables in function calls as above, disclosed is a technique of creating an alias-oriented flow graph by Archambault. Archambault, in a technique similar to the reaching definition analysis by Pande and optimizing pointer discloses assigning a initial set of alias node with initial information saved therein (col. 5, lines 6-15 – step a); adding successors node to an alias-node (e.g. *pseudo* – col. 5, lines 18-23 – step c); updating initial value based on type of instruction involving definition node or R-val variable and use node or R-val actual value(e.g. Fig. 1; Fig. 2, Fig. 3, i.e. step d – Note: R-val resolution is equivalent with PUT(A,E) format statement). But Arcambault does not disclose step (b); but official notice is taken that starting a iteration by using a set of elements with a defined size and discounting from such total size count each element every time it is processed as per one iteration was a known concept at the time the invention was made. Hence, this step (a) would have been obvious for Archambault to use in order to keep track with the working set of created alias nodes. In view of the teachings by Pande and Harrold to keep track with data being resolved in the flow as staged with consideration for argument passing set, alias naming and input/output set or reachability,

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the implementation by Archambault being provided as an enhancement to Pande or Harrold's method would have been obvious for one skill in the art at the time the invention was made because in doing so all the intraprocedural alias-related reference would be solved and propagate this into the interprocedural techniques as taught by Harrold ( see Fig. 3, pg. 182) or suggested by Pande (*intraprocedural* - ch. 4.1.3, pg. 144-145) to achieve the code optimization and alias resolution techniques as intended by both Harrold and Pande.

**As per claim 6**, Panda and Harrold do not disclose that said initial value comprises a set of abstract values which forms a join-complete partial order. But official notice is taken that initializing each element in a set to be processed by an algorithm as suggested by Archambault when creating alias node and associated variables was a known concept. Hence, by resolving the initial data being stored at the variables representing alias node, the concept of completing a partial order is disclosed, i.e. joining the initial value with the actual value and put forth the final result as the most significant of the two ( see Archambault, Fig. 2-3). Hence, this would have been obvious by virtue of the above rationale.

**As per claims 11-12**, these claims correspond to claims 5-6, respectively; and are rejected with the corresponding rejection as set forth therein.

**As per claims 17-18**, these claims correspond to claims 5-6, respectively; and are rejected with the corresponding rejection as set forth therein).

### ***Conclusion***

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan A Vu whose telephone number is (703)305-7207. The examiner can normally be reached on 8AM-4:30PM/Mon-Fri.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on (703)305-9662.

**Any response to this action should be mailed to:**

Commissioner of Patents and Trademarks

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VAT  
September 24, 2004

*Kakali Chaki*  
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